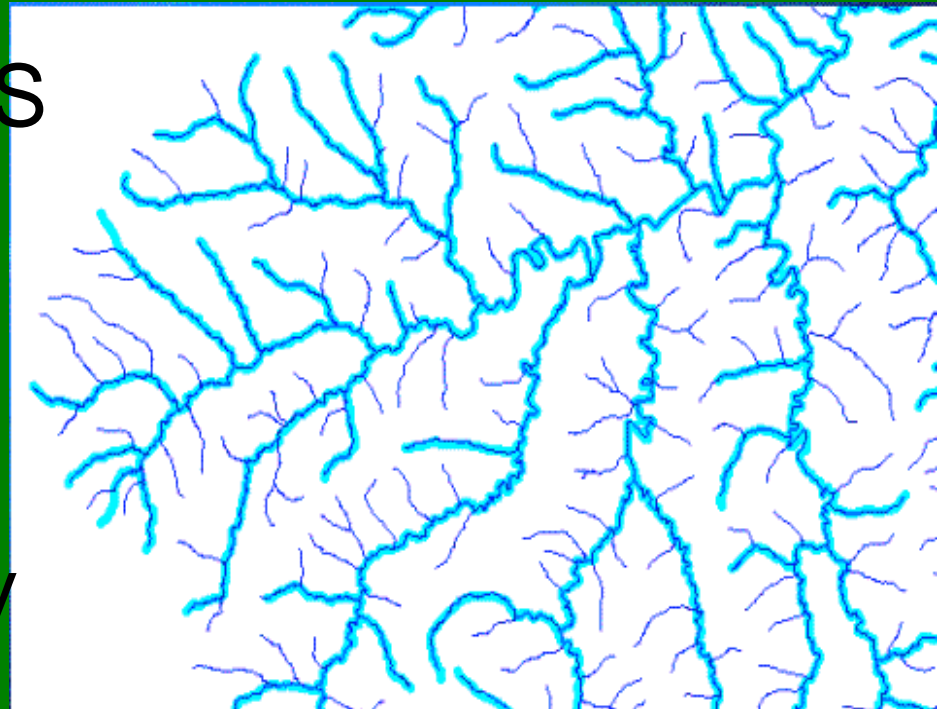


National Hydrography Dataset (NHD)

Charley Hickman USGS
chickman@usgs.gov

Steve Miller, MDEQ
millers6@michigan.gov



National Hydrography Dataset

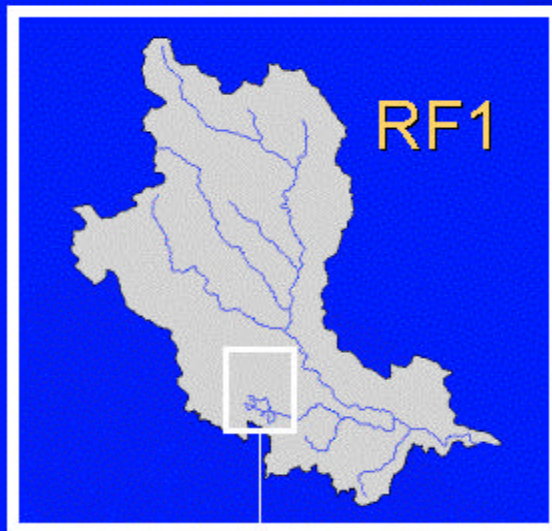
A comprehensive set of digital spatial data that contains information about:

- naturally occurring and constructed bodies of water**
- natural and artificial paths through which water flows**
- related hydrographic entities.**

Seamless Data

- Not quad based
- Online access
- GIS ready
- Transactions
- Versions
- Variable-resolution
- Update features as needed
- Feature-level metadata

Reach File History



1982



1:500,000
Centerlines & Shorelines
No Waterbodies
68,000 reaches



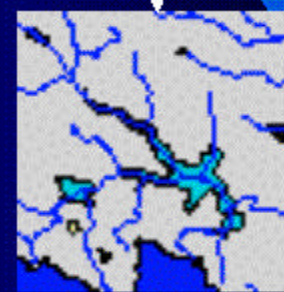
1992



1:100,000
Shorelines
No Waterbodies
3,000,000+ reaches

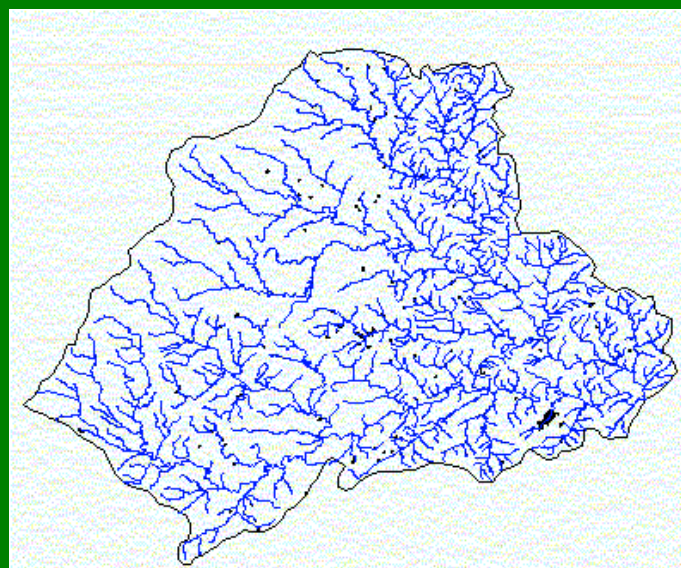
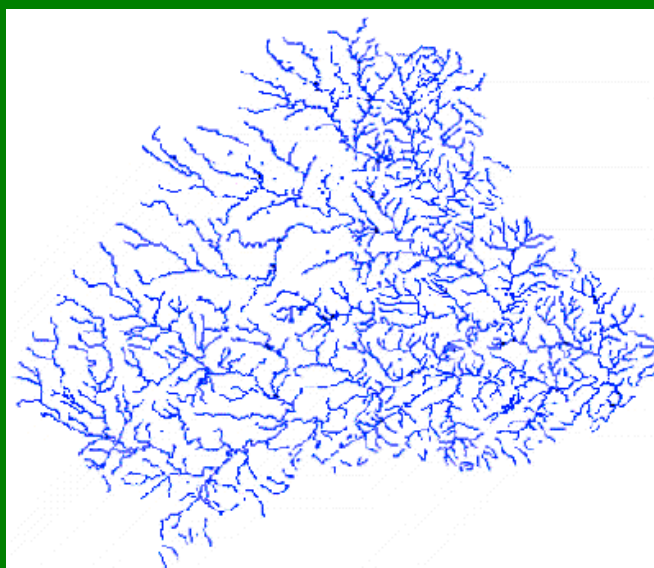
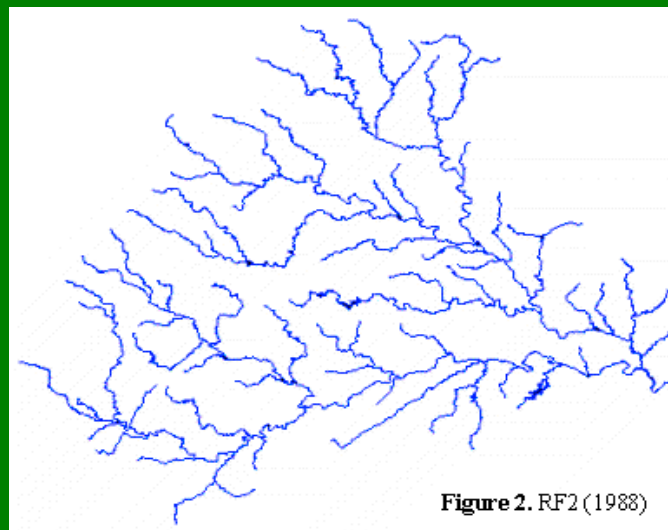
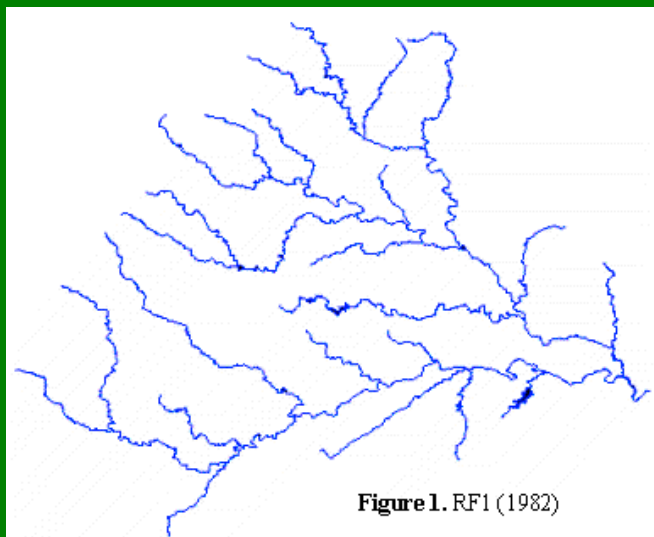


1999

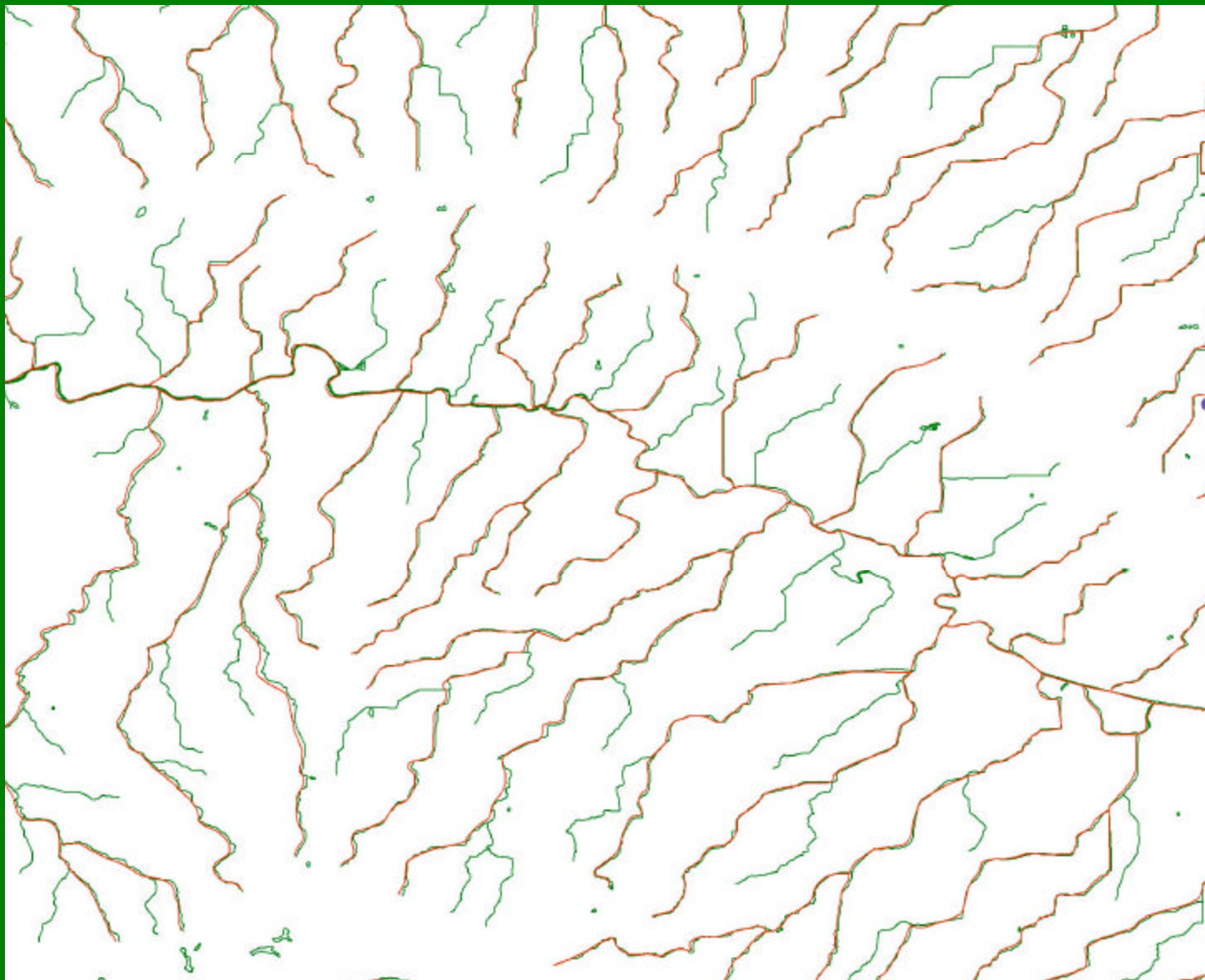


1:100,000
Centerlines & Waterbodies
52 Carto Feature Types
3,000,000+ reaches

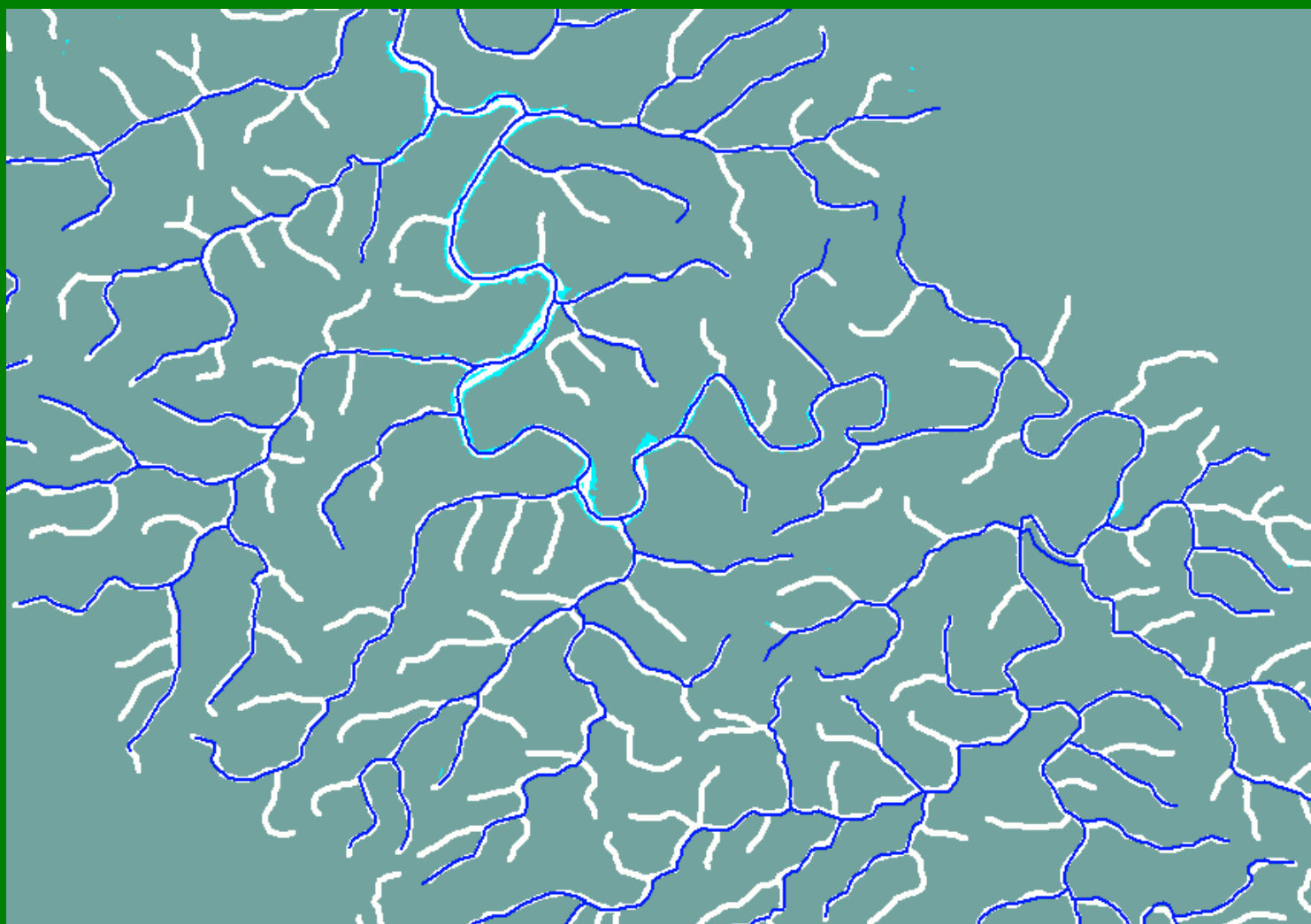
Reach Files – RF1, RF2, RF3, NHD



100K NHD and 24K NHD



100K NHD and 24K NHD



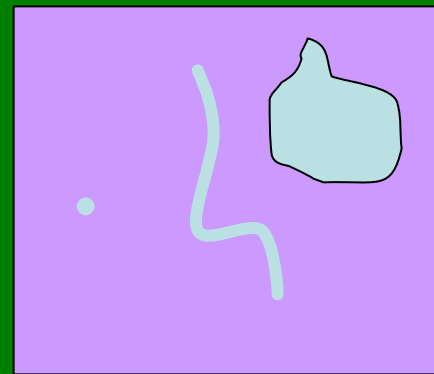
Main Components

- Features
- Reaches
- Flow relationships
- Geographic names
- Level paths
- Coordinates and measures
- Metadata

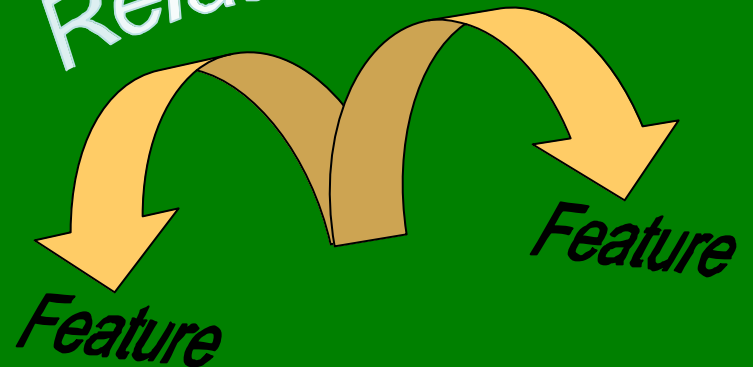
Attributes

Geometry

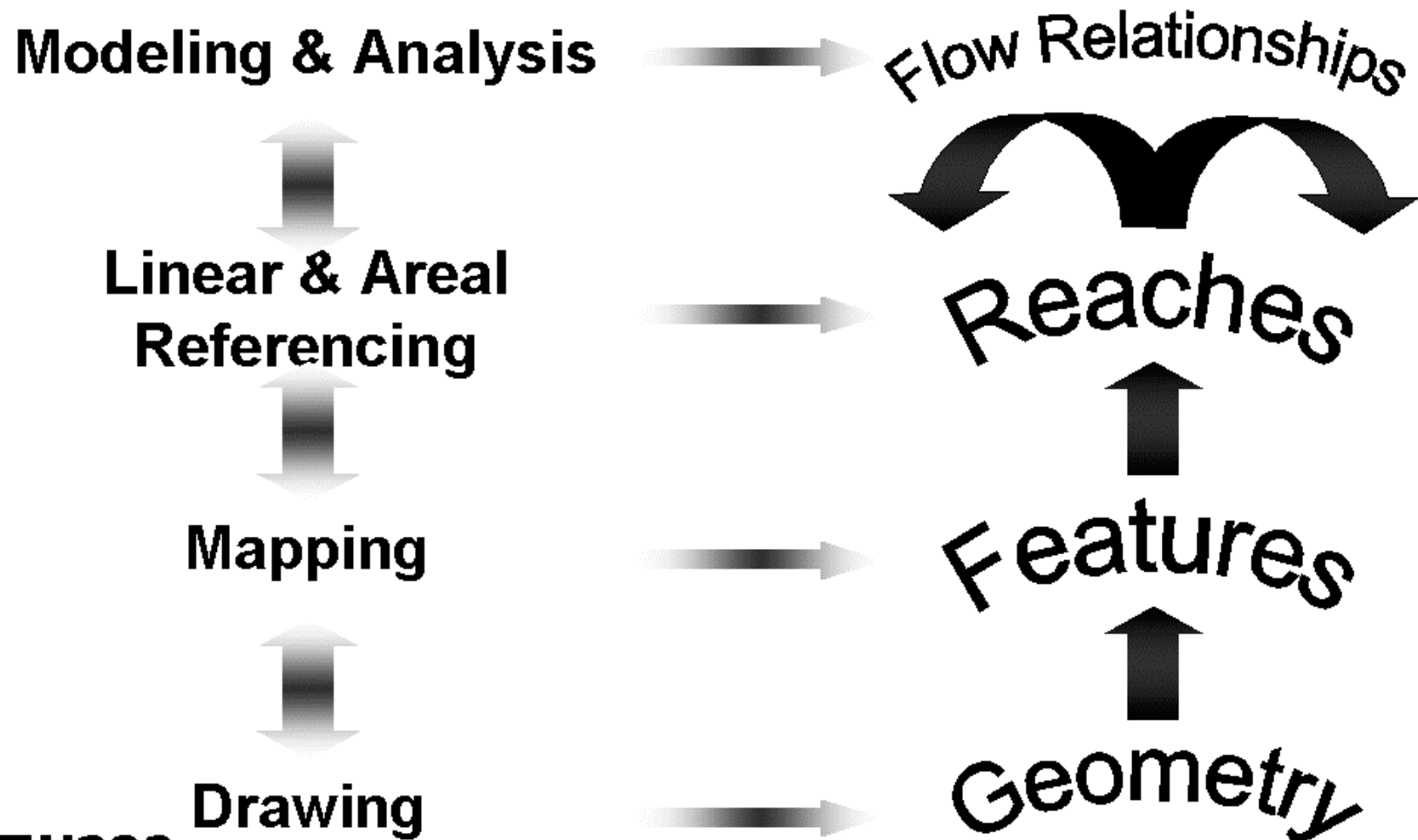
Features



Relationships



Application ↔ **NHD**

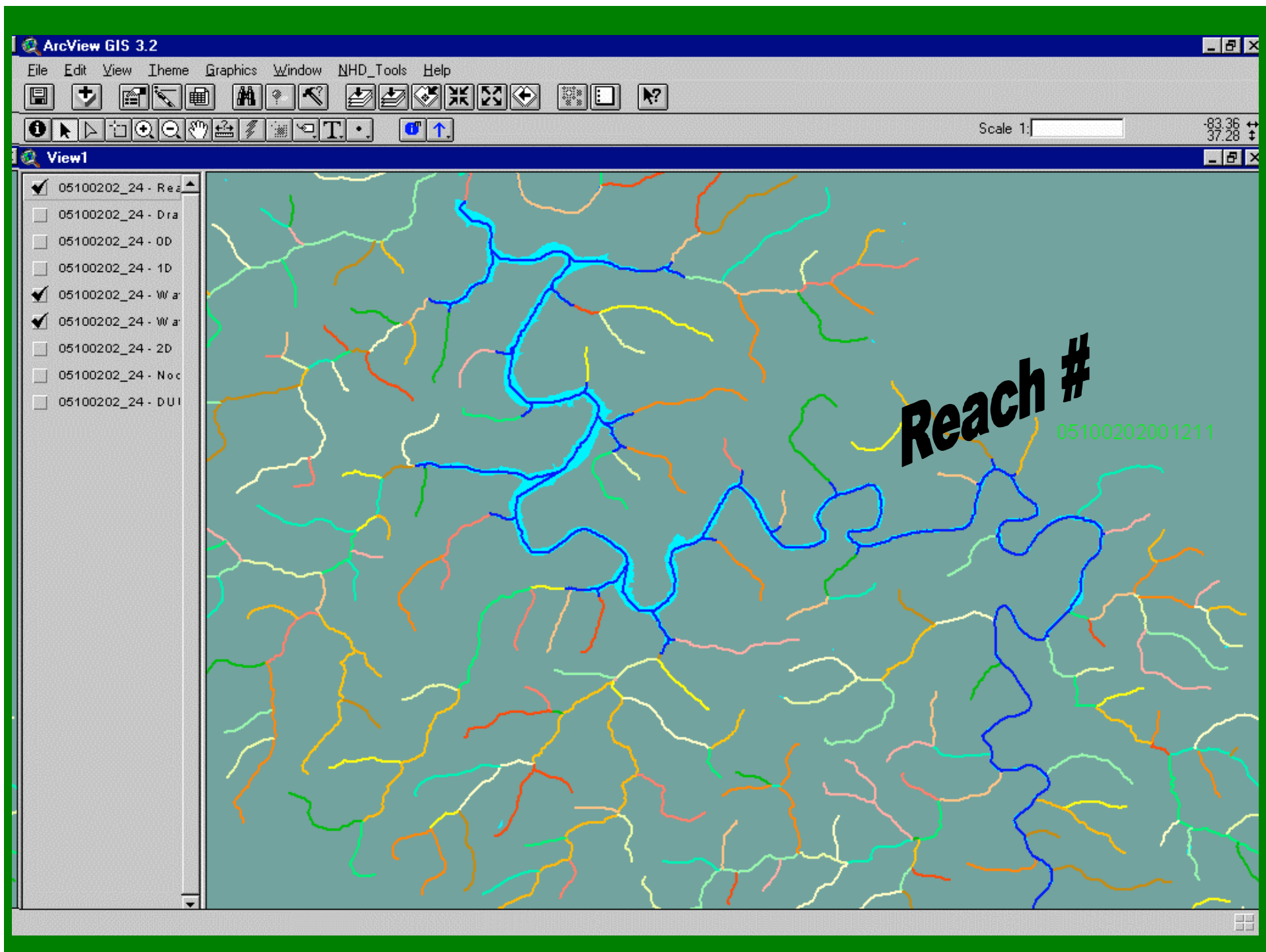


Features

- Represent bodies of water, paths through which water flows, and related hydrographic entities
- Contain the information found on USGS topographic maps:
 - Stream network – streams, canals, other paths: 80%
 - Water bodies – lakes, reservoirs, other areas: 14%
 - Landmarks – dams, bridges, geysers, other items: 6%
- Classified by feature type using:
 - A five-digit feature code
 - Text aliases for the feature code in a lookup table

Reaches

- Segments of surface water with similar hydrologic characteristics
- Unique reach code identifies each reach
 - Cataloging unit number + sequential number
- Three types of reaches implemented
 - Transport (lines oriented in direction of flow)
 - Coastline (lines oriented so water is on right)
 - Waterbody



Reaches in RF3 and NHD

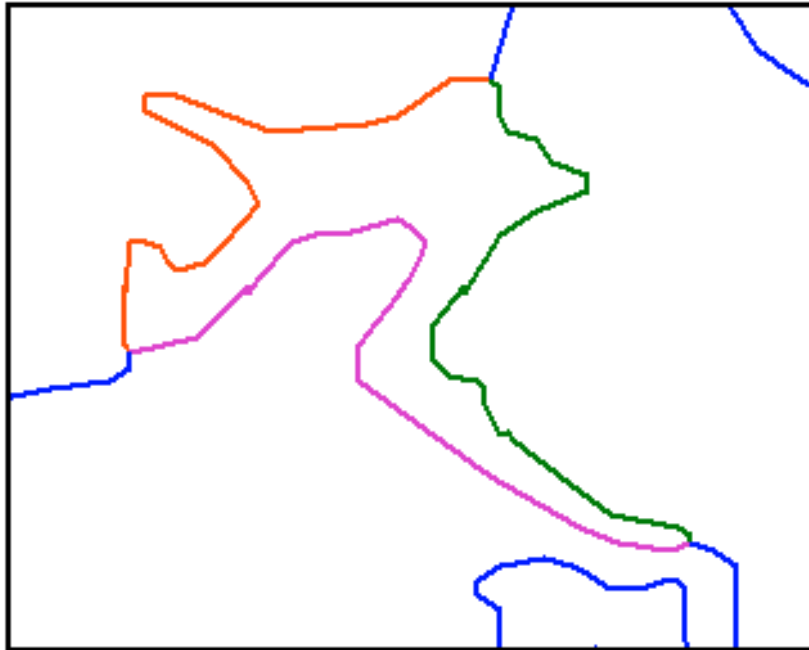


Figure 1: Lake representation in RF3; the lake actually consist of 3 reaches (red, green, purple).

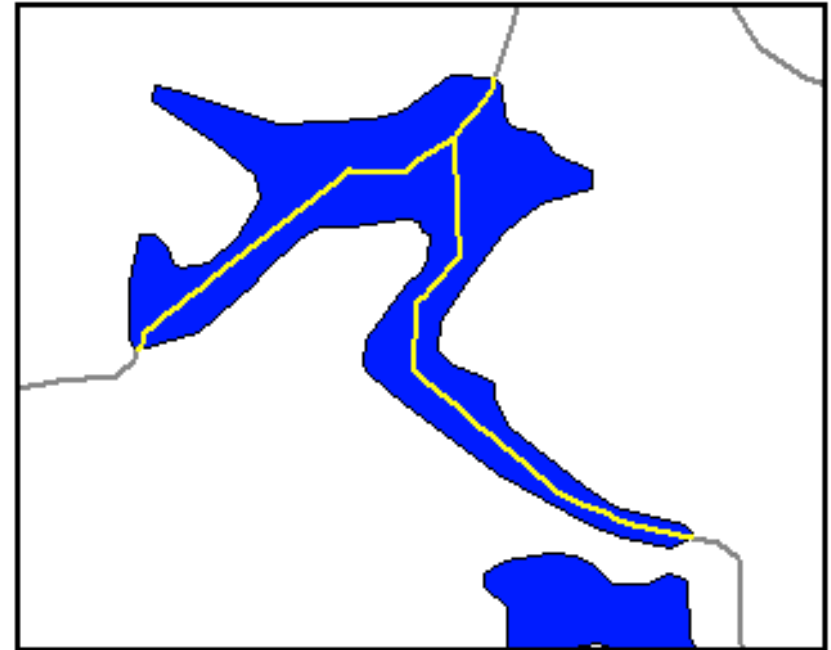


Figure 2: Lake representation in NHD; the lake consists of a polygon and a single reach (artificial path)

From Spoerri, Miller, and Dabolt, 2000

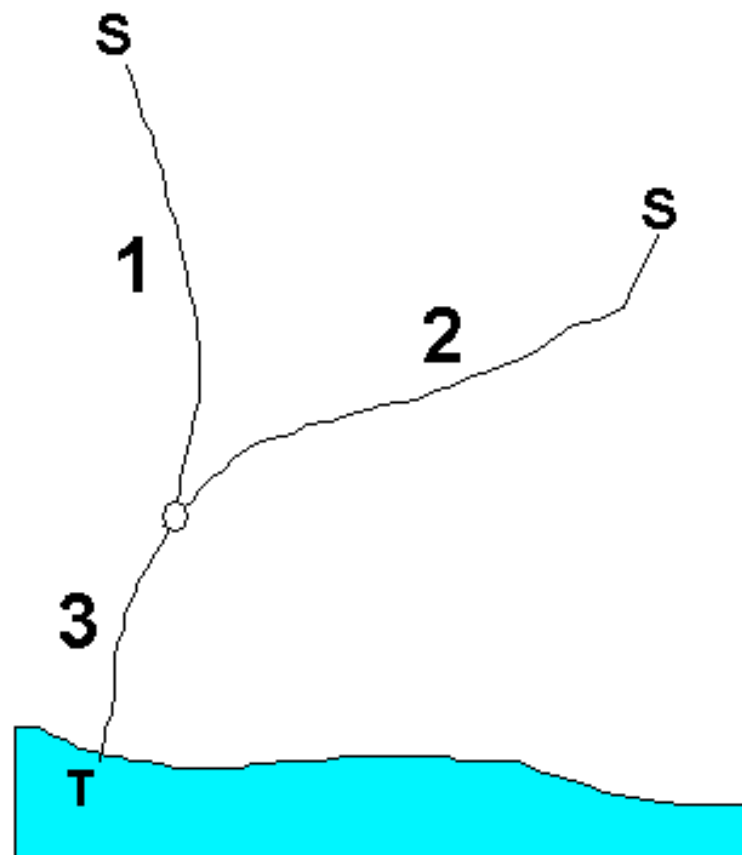
Geographic Names

- The proper name, specific term, or expression by which a particular geographic entity is known
- An identifier maintains a link to the Geographic Names Information System
- Reaches carry the geographic name most often; features only carry the name if they are not part of a reach.

Relationship Between Reaches

- **Flow relationships link individual transport and coastline reaches to form the surface water drainage network**
- **Flow relationships describe**
 - **The network connectivity between reaches**
 - **The direction of water flow between transport reaches**
 - **The traversal of the coastline along coastline reaches**
 - **The order of termini of individual drainage networks along the coastline**

Relationships between reaches

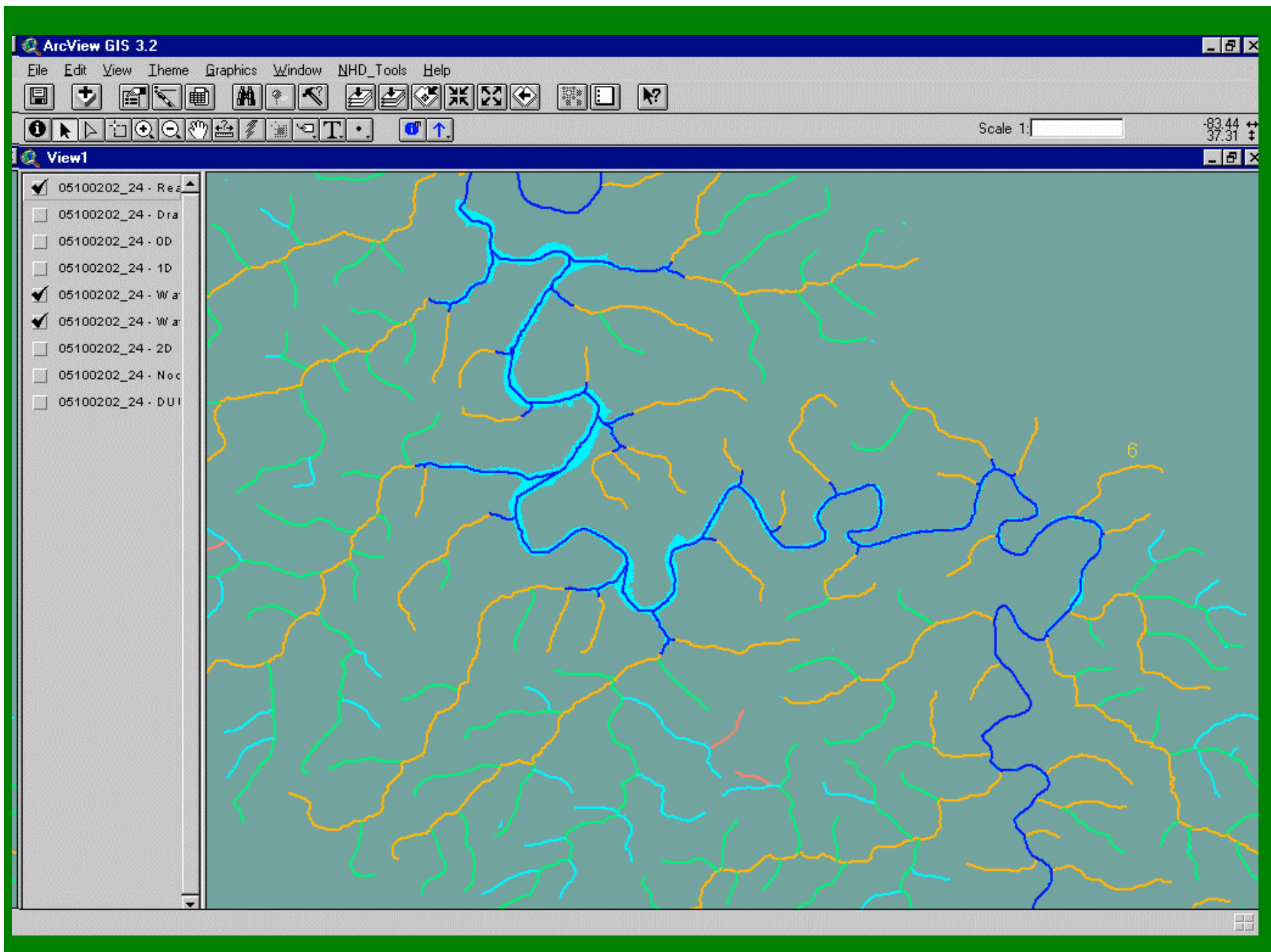


Flow Table

Rch1	Rch2	Seq	Direction
1	3	0	In
2	3	0	In
-	1	0	Start
-	2	0	Start
3	-	0	Terminal

Level Paths

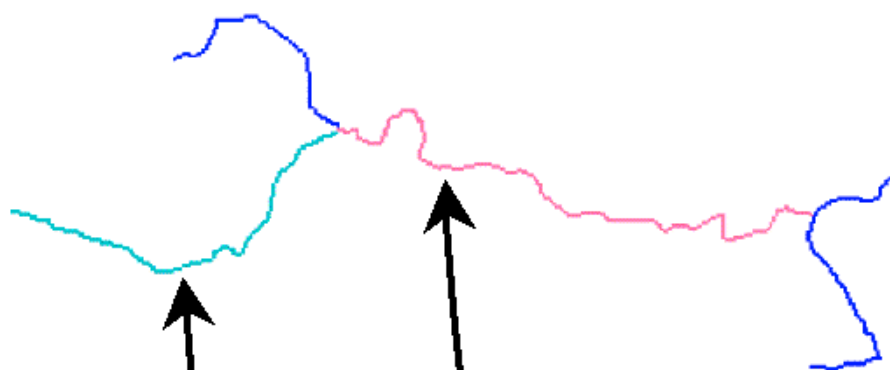
- The ordered set of transport reaches that trace the main path for a given flow of water
- Identifies the main path to which a particular transport reach belongs
- Still working on implementation



Metadata

- Metadata, or data about data, describes the content, quality, condition or other characteristics of data
- Uses the FGDC metadata standard
- In the initial release of the data, there is metadata for
 - The entire NHD
 - Collections of features or reaches, normally organized by
 - quadrangle digital update units for features
 - cataloging unit digital update units for reaches

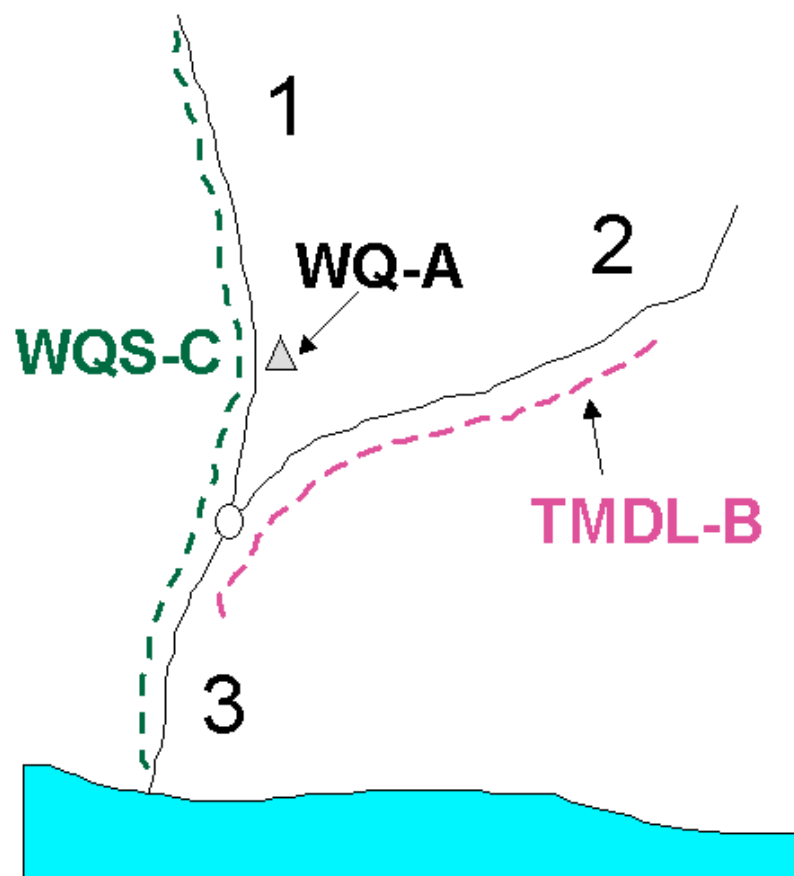
Linear referencing



Purpose	Entity ID	Reach Code
TMDL (303d)	IA 02-WFC-0120_07080204_1	07080204000080
WBS (305b)	IA 02-WFC-0120_449 0	07080204000080
DWS	3143	07080204000082
DWS	3142	07080204000082
Flow Gages	USGS054600 00	07080204000082
PCS	IA0058441	07080204000082



Linear referencing



Description	Program System ID	Reach ID	Begin Position	End Position
WQ Monitoring	WQ-A	1	30	-
303(d) Listed	TMDL-B	3	65	100
		2	0	80
Water Quality Standard	WQS-C	3	0	100
		1	0	100

NHD – Applications and Related Programs

How is NHD used?

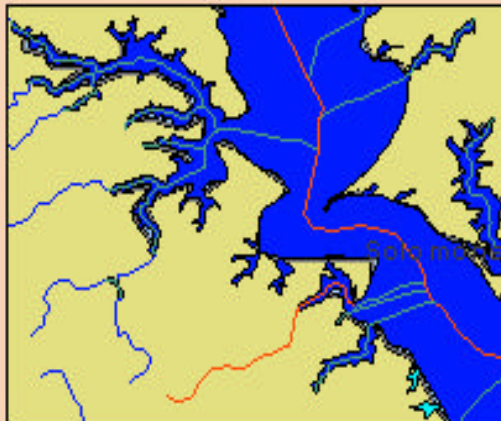
- **Support inventory, analysis, visualization, mapping, modeling . . .**
- **Water quality, flooding, fish . . .**

WATERS - Watershed Assessment, Tracking & Environmental Results System

Query Tool

Total Waters

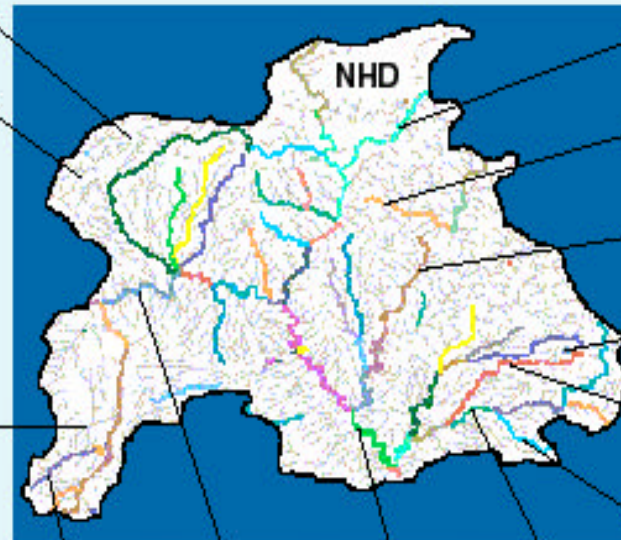
EnviroMapper for Water
(web Interface)



DISPLAY	LABEL ALL	ACTIVE		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>		Impaired Waters
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>		Water Quality Standards
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>		Assessed Waters
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="radio"/>		Beaches

Internet

NHD Reach Address Database (RAD)



impaired waters
assessed waters
designated uses
monitoring stations
outfall locations
fish consumption advisories

NHD Reach Indexing Tools

TMDL tracking
NAD
WQS database
STORET
PCS
NLFWA

sewage NDZs
beach closures
nutrient stations
319 grant Projects

NHD Reach Indexing Tools

BEACH
Watch DB

Nutrient
Criteria DB

GRTS



WATERS



WATERS Tool that uses
information from the RAD



NHD Reaches



NHD Reach Addressing
Database (RAD)



Water address events
stored in NHD RAD



Major program database

NHD – Applications, Related Programs, and Tools (1)

- RIT - Reach Indexing Tool for NHD - georeferencing surface water databases to NHD
- BASINS - Better Assessment Science Integrating Point and Nonpoint Sources - integrated watershed environmental modeling
- CWAEM - Clean Water Act Effects Model - basic water quality modeling and economic analysis
- NAWQA - National Water-Quality Assessment Program
- NLFWA - National Listing of Fish and Wildlife Advisories

NHD – Applications, Related Programs, and Tools (2)

- WATERS - EPA Water Assessment, Tracking & Environmental Results
- Section 303d, Clean Water Act
- TMDL - Total Maximum Daily Load
- Section 305b, water quality assessment
- STORET - data STOrage and RETrieval system - water quality data repository

NHD – Applications, Related Programs, and Tools (3)

- **NRS - EPA National Recreation Survey**
- **NWIS - National Water Information System**
- **NWPCAM - National Water Pollution Control Assessment Model - modeling economic benefits related to water quality**
- **RIMDESS - River Management Decision Support System - modeling point and nonpoint discharges, nutrient routing and decay, and nitrogen loading in rivers and estuaries**

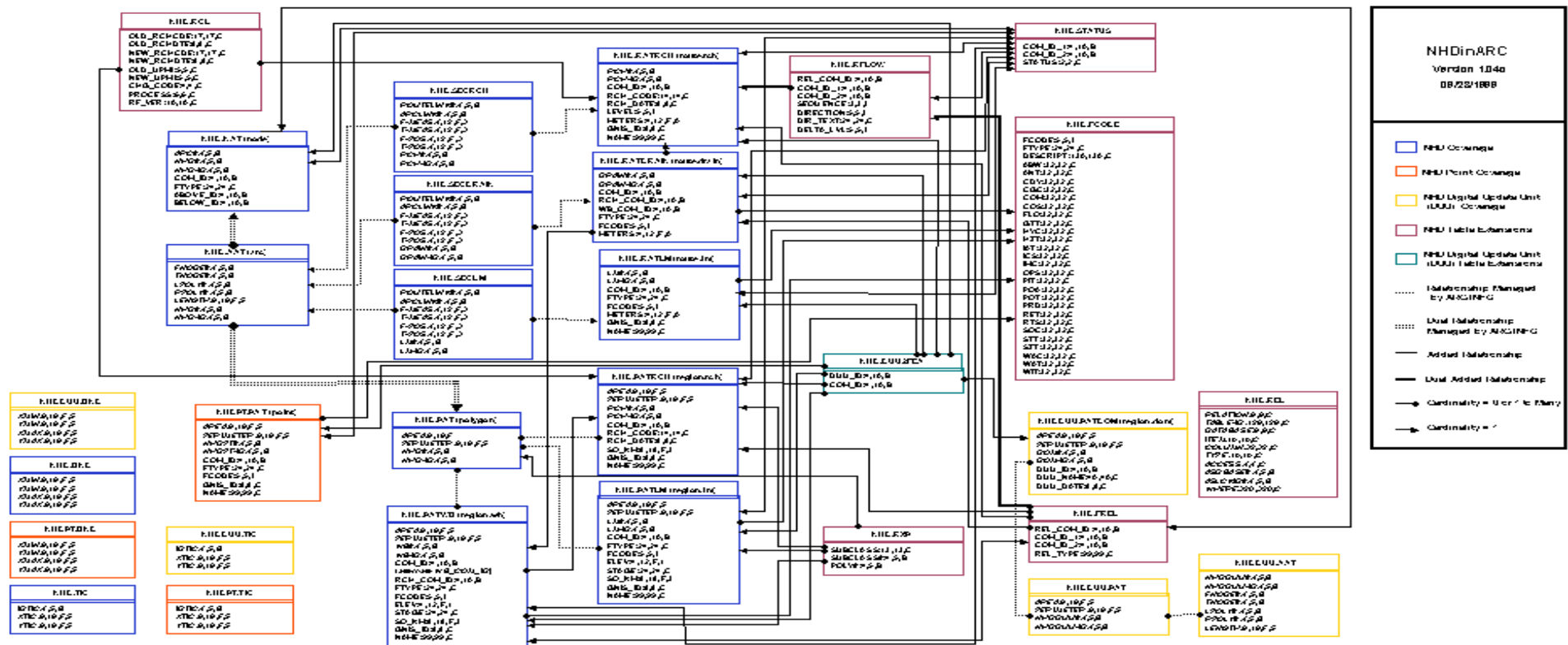
NHD – Applications, Related Programs, and Tools (4)

- **SPARROW - Spatially Referenced Regression of Contaminants on Watershed Attributes**
- **WQSDB - Water Quality Standards Database**
- **USGS Gaging Station info linked to NHD - Dave Stewart of USGS WRD**
- **NHD Flow Volume and Velocity Estimator**
- **NHD Stream Order Tool**

NHD – Applications, Related Programs, and Tools (5)

- NHD ArcView Tool Kit
- NHD Names Update Tool
- USGS National Rivers Information Center - prototype
- GRT non-point source projects
- NPL - water-related National Priority List locations
- Aquatic GAP

NHDinARC GeoRelational Model



(Use of trade, product, or firm names is for descriptive purposes only and does not imply an endorsement by the U.S. Government.)

ArcGIS Hydro Data Model

<http://arconline.esri.com> in the data models section

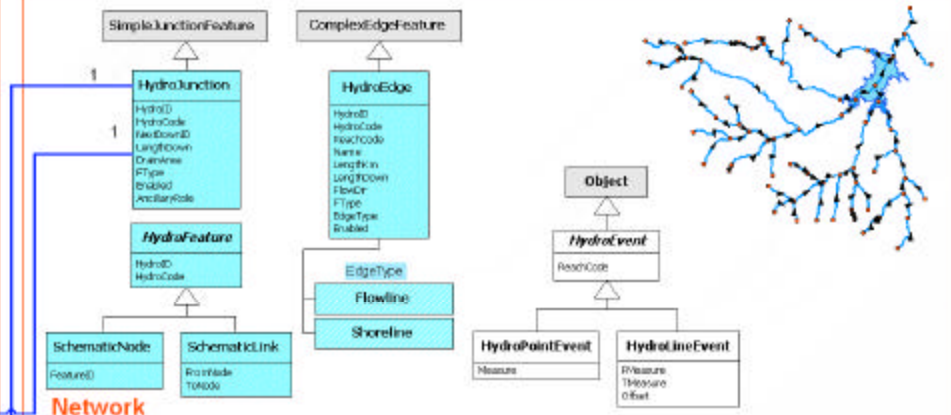
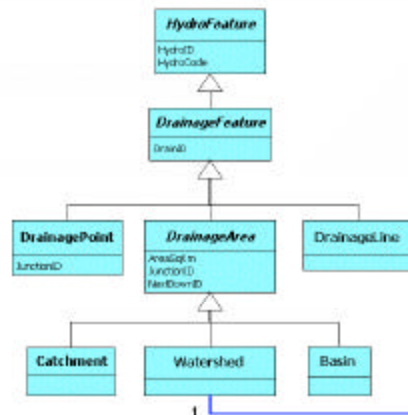
<http://www.cwr.utexas.edu/giswr>



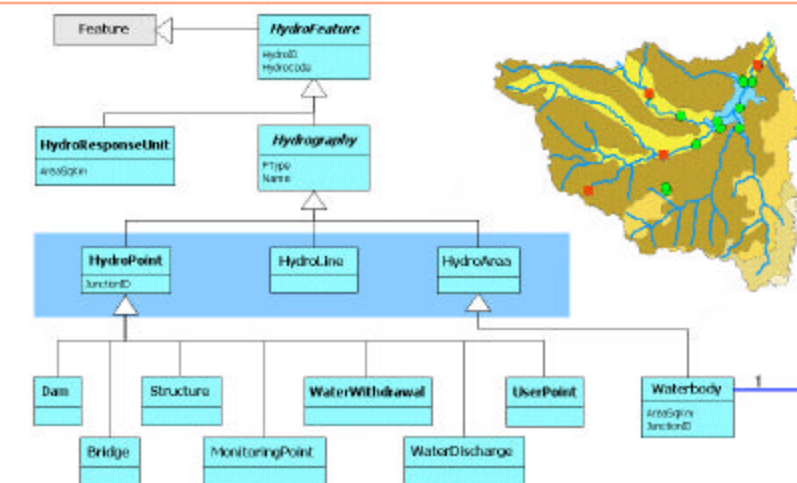
GIS in Water Resources Consortium



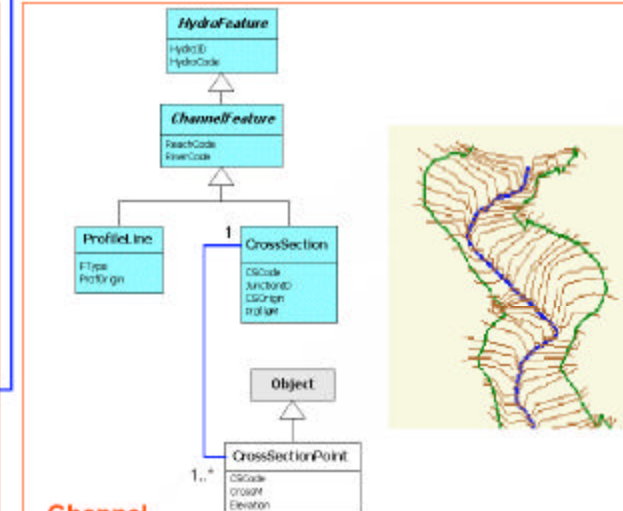
Drainage



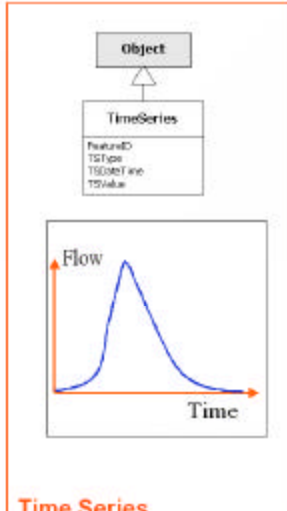
Network



Hydrography

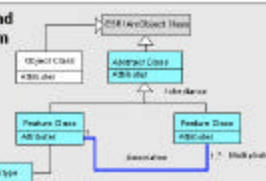


Channel



Time Series

How to read this diagram



Types of Classes

ESRI Object Class: (yellow box) is a generic object class provided with the ArcGIS software. All ArcGIS Hydro classes inherit from one of these classes (Object, Feature, Network, Feature).

Abstract Class: (Class Name in italics) is a class which stores common attributes shared by the classes inheriting from it. It does not have objects of its own.

Object Class: (yellow box) is a class represented as a Table in which each object has an ObjectID and Attributes.

Types of Classes

Feature Class: (yellow box) is an object class that has spatial coordinates (Point, Line, Area).

Abstract Feature Class: (yellow box) is a feature class that has connectivity between Junctions (points) and Edges (lines).

Abstract Value Domain: is an attribute containing numerical code with a text label. It is used for Type attributes.

Class Subtype: (blue and white pattern) is a separate class defined by a Dotted Value Domain type attribute.

Types of Relationships

Inheritance: (indicated by a triangle) means that the classes below inherit the properties and methods of the classes above them in the class hierarchy.

Association: (indicated by a blue line) links objects in two classes using common values of any attribute fields stored in both classes.

Multiplicity: specifies how many objects can be associated with another object in an Association.

1: One and only one.

1..*: From one to any positive integer.

Components

All features in the model are **Hydro Features**.

Hydrography Features: are the flow lines in maps, and point features from tabular data inventories.

Drainage Features: define the drainage areas of the landscape.

Network Features: describe the connectivity of water flow through the landscape.

Channel Features: provide a 3 dimensional view of channel shape.

Time Series: store time varying data about the water properties of any feature.

Attributes of Hydro Features

HydroID: is an integer identifier for hydro features which is unique within the grid/catchment.

HydroCode: is a string identifier for hydro features which is then permanent public identifier.

JunctionID: is the HydroID of an associated hydrojunction. This junction is the outlet location for Drainage Areas and Watersheds.

FeatureID: is the HydroID of an associated hydro feature.

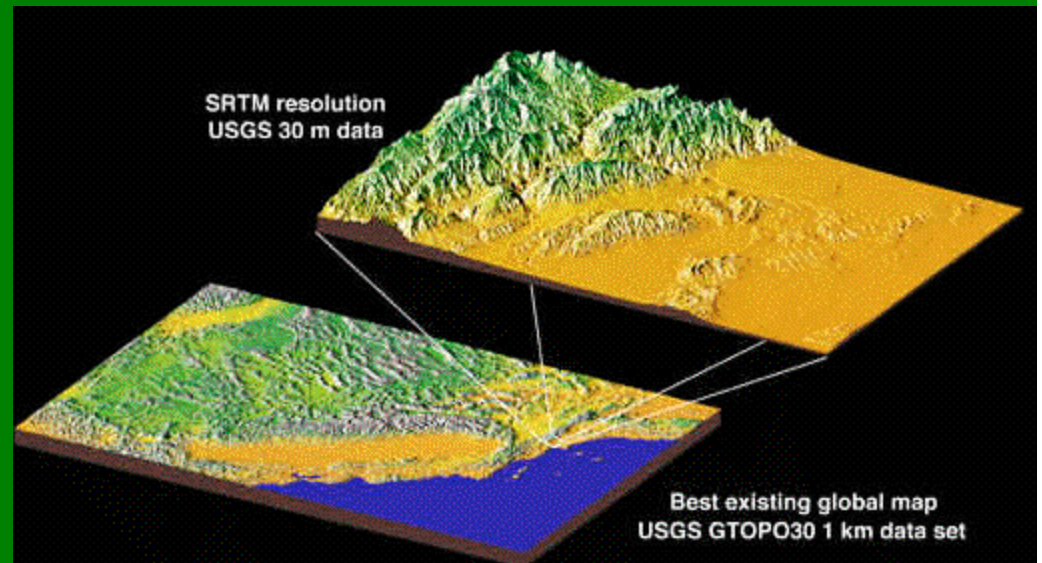
FlowDownID: is the HydroID of the next downstream feature in the data.

The National Map: Data Characteristics

- Seamless
- Consistently classified
- Variable resolution, completeness
- Consistency and integration among themes of data
- Current to within seven days
- Variable positional accuracy without cartographic offsets

National Elevation Dataset (NED)

- Filtered
- Edge matched
- Common datum
- Common coordinate system
- One arc second (30 meter) spacing
- Future 10 meter, LIDAR, SRTM





National Elevation Dataset

[Home](#)
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[Data](#)
[Samples](#)
[FAQ](#)
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INDIANA GEOLOGICAL SURVEY

2002

January
S M T W T F S
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

February
S M T W T F S
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28

March
S M T W T F S
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

April
S M T W T F S
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30

May
S M T W T F S
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

June
S M T W T F S
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30

July
S M T W T F S
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

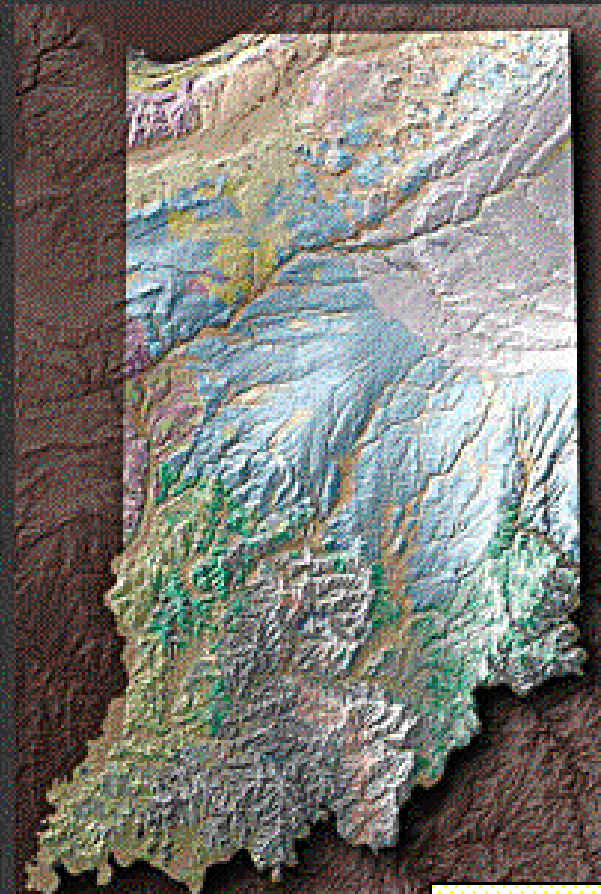
August
S M T W T F S
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

September
S M T W T F S
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30

October
S M T W T F S
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

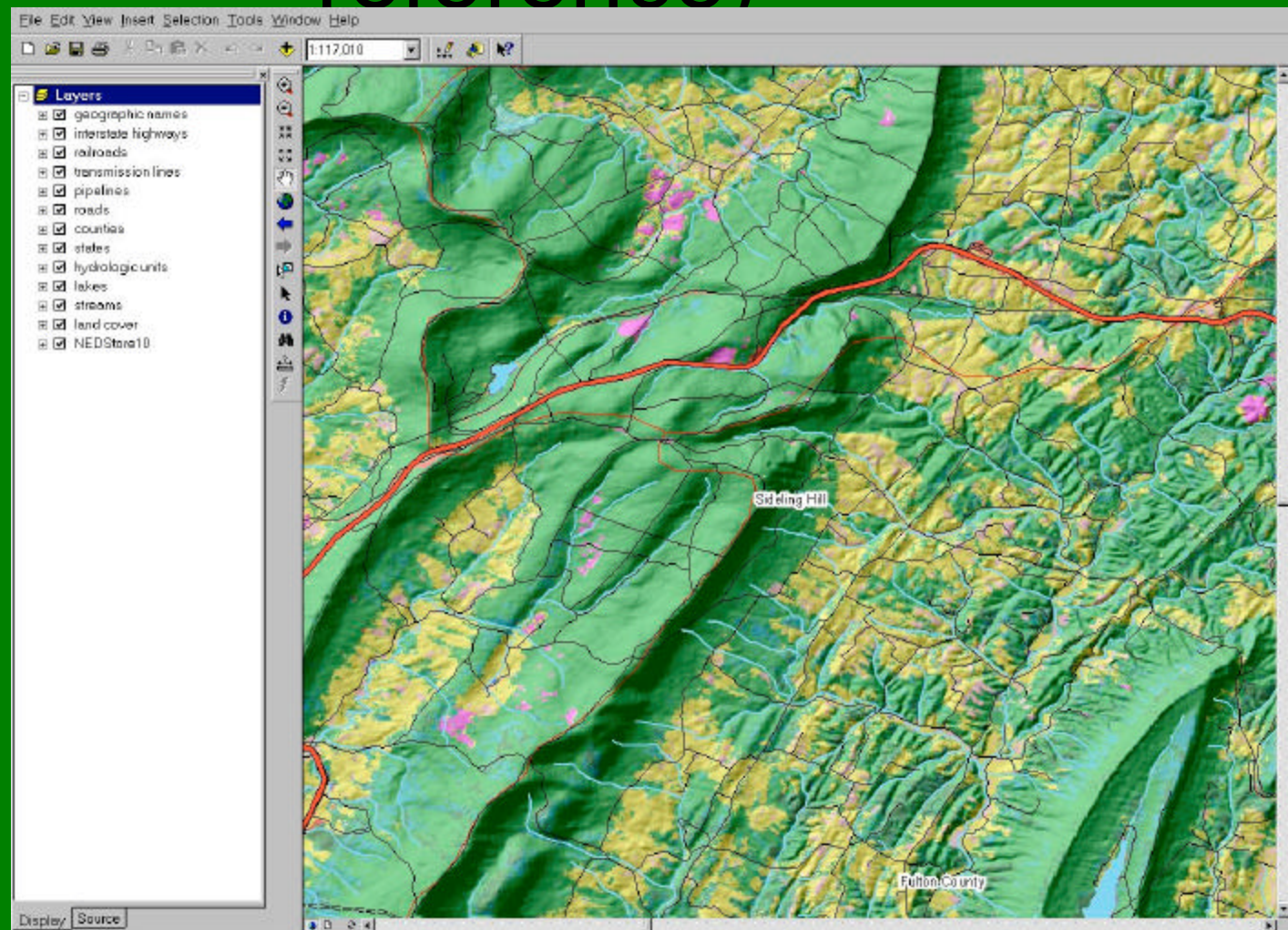
November
S M T W T F S
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30

December
S M T W T F S
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31



IGS 2002 wall cal

National Land Cover Dataset (on NED shaded relief, plus reference)



Watershed - Sub-basin



Obtaining Status, Data, and More Information

- National Hydrography Dataset site
<http://nhd.usgs.gov> contains
 - Online access to download data
 - Technical references
 - Tutorials
 - Tools
- Data on media can be ordered at
<http://edc.usgs.gov/webglis>
- Help at
nhd@usgs.gov

[text version](#)[NHD Home](#)[Technical References](#)[Data](#)[Tools](#)[Application Demo](#)[Tutorial Series](#)[Technical Support](#)[Maintenance](#)

National Hydrography Dataset



The National Hydrography Dataset (NHD) is a comprehensive set of digital spatial data that contains information about surface water features such as lakes, ponds, streams, rivers, springs and wells. Within the NHD, surface water features are combined to form "reaches," which provide the framework for linking water-related data to the NHD surface water drainage network. These linkages enable the analysis and display of these water-related data in upstream and downstream order.

The NHD is based upon the content of USGS Digital Line Graph (DLG) hydrography data integrated with reach-related information from the EPA Reach File Version 3 (RF3). The NHD supersedes DLG and RF3 by incorporating them, not by replacing them. Users of DLG or RF3 will find the National Hydrography Dataset both familiar and greatly expanded and refined.

While initially based on 1:100,000-scale data, the NHD is designed to incorporate and encourage the development of higher resolution data required by many users.

NHD News

The NHD data server is experiencing problems and is currently unavailable (4/16/01)

[Slides and Videos from the NHD Applications Symposium](#)
(2/28/01)

[NHD News Archive](#)[Search USGS](#) | [USGS](#) | [EPA](#) | [FGDC](#)

[U.S. Department of the Interior](#)
[U.S. Geological Survey](#)



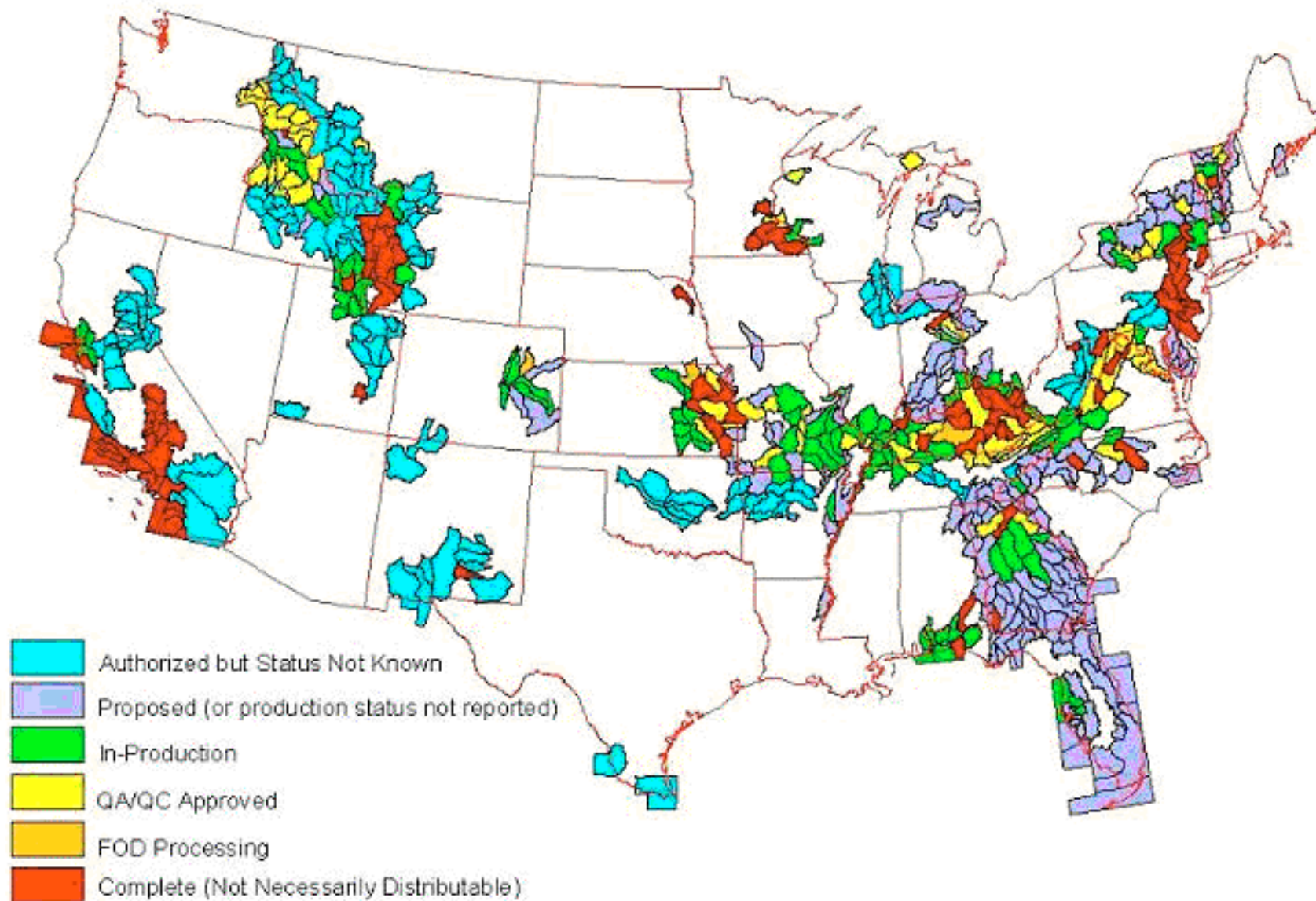
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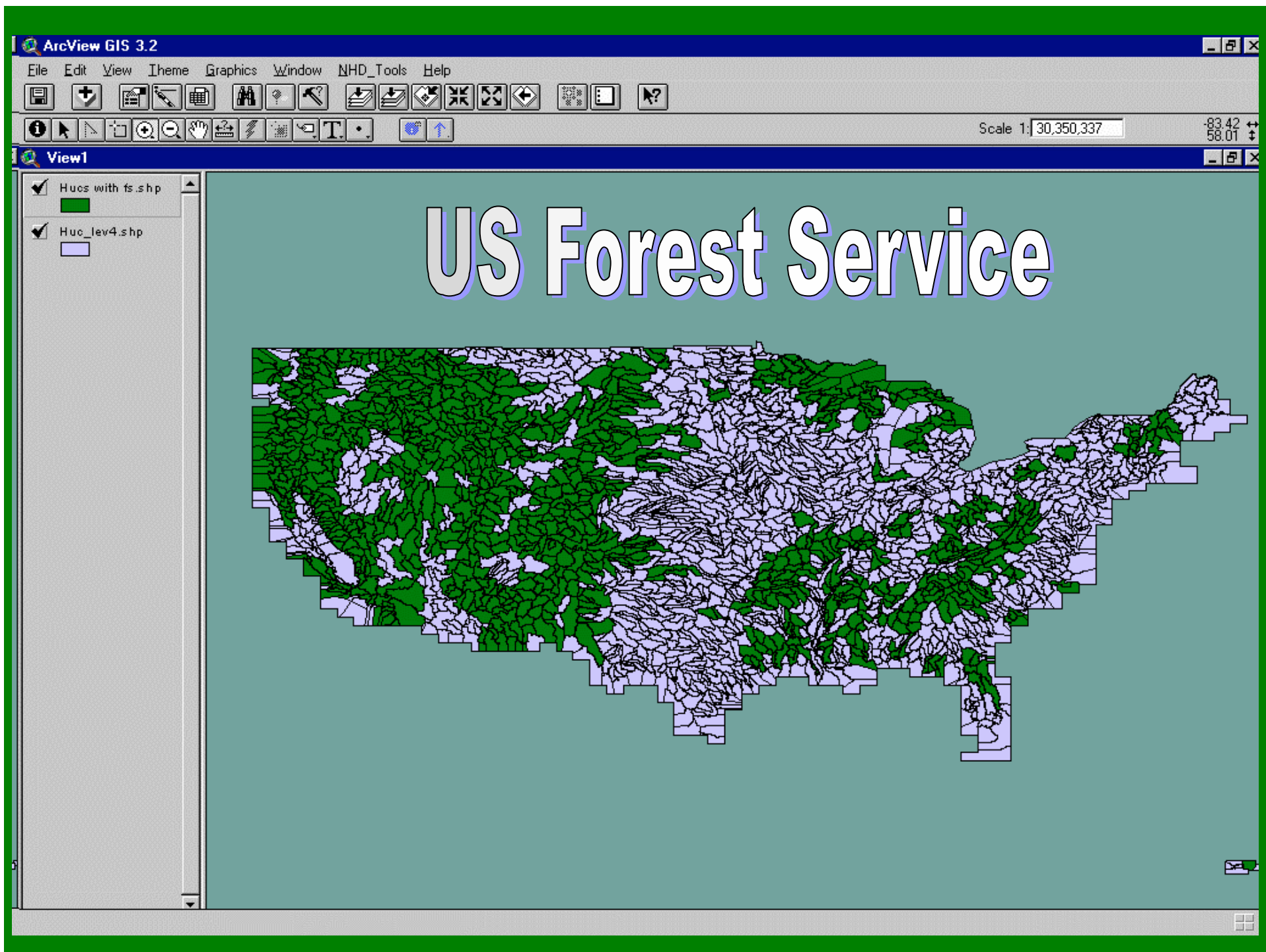


Getting Copies of the Data

- “NHDinArc” – tarred and compressed ArcInfo workspaces
- Workspace contains
 - Data for one hydrologic cataloging unit (sub-basin)
 - Three ArcInfo coverages plus several related INFO tables
 - Folder containing the text metadata files

High Resolution NHD Status 3/29/02





National Hydrography Dataset

- National program
- Combine hydro spatial data programs of
 - USGS DLG
 - EPA RF3
 - USFS CFF
 - other national, state, and regional partners
- Coordinate update efforts

NHD Stewards

- The NHD is a living dataset
- Revision updates needed
- Quality updates needed
- Organizations closest to the hydrography are most aware of ground truth
- Such organizations should have the opportunity to serve as stewards
- The USGS will assist

National Hydrography Dataset





**Michigan NHD
Stakeholders Meeting
April 15-16, 2002
Lansing, Michigan**

CGI - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites History Print Mail W Address http://www.michigan.gov/cgi Go Links

 **Center for Geographic Information**
Department of Information Technology

 **Michigan.gov**
An Official State of Michigan Web Site

[Michigan.gov Home](#) | [CGI Home](#) | [Sitemap](#) | [FAQ](#) | [Inside CGI](#) | [Contact CGI](#) | [DIT Home](#) Search go

MI Map Gallery
MI Mapper
MI Geographic Data Library
Programs, Projects & Initiatives
Geographic Information Standards
Outreach & Promotion
Grant Opportunities

MI Geographic Names Authority
MI Geographic Framework Network

LOGIN to Michigan.gov >

What's New

2000 US Census Bureau Urban Area Boundaries
These are Statewide shapefiles representing as derived from 2000 TIGER in a ZIP format.
> [More](#)

Computer World Honors - Case Study
Interactive digital aerial images of Michigan's 83 counties delivered on CD-ROM, support a wide range of activities among users who never before had such high-quality maps.
> [More](#)

CGI Established
Governor Engler heightens the awareness and use of geographic information technology by establishing the Michigan Center for Geographic Information (CGI).

What's New

The Michigan Center for Geographic Information (CGI)

The Michigan Center for Geographic Information (CGI) provides leadership, technical expertise and policy for the development, use, dissemination, promotion and sharing of geographic information in the state of Michigan. The Center's mission will enable state government to more effectively and efficiently serve the citizens, businesses and other governments of the state in areas of public protection, homeland security, economic development, environmental protection and transportation.

Highlights

- **CGI Established**
State of Michigan Center for Geographic Information Established 8/1/98, 2000

Coming Events

- **MiCAMP GIS Conference**
7th Annual Michigan County GIS Conference 9/12 - 9/13, 2002

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click here to see how...

Quick Links

- > [National States Geographic Information Council](#)
- > [Great Lakes Information Network](#)
- > [Urban and Regional Systems Association](#)
- > [Association of Michigan Geographers](#)
- > [American Society for Photogrammetry & Remote Sensing](#)
- > [Geospatial Information & Technology Association](#)
- > [Federal Geographic Data Committee](#)
- > [U.S. Geological Survey](#)
- > [U.S. Environmental Protection Agency](#)
- > [U.S. Census Bureau](#)

www.michigan.gov/cgi

Microsoft Excel
Perform calculations, analyze information, and manage lists in spreadsheets or Web pages by using Microsoft Excel.

drography Da... CGI - Microsoft Intern...

Internet 12:24 PM